SI-ER-915

FIRST QUARTERLY REPORT

MANUFACTURING METHODS AND TECHNOLOGY PROJECT TO ESTABLISH PRODUCTION TECHNIQUES TO MANUFACTURE RIGID ARMOR FOR RADAR ANTENNA HARDENING.

REPORT PERIOD Quarterly Sept. No. 1,
1 JUN[redacted]-31 AUG[redacted]77.

R. Dorn

Jan 77

TECHNICAL SUPPORT DIRECTORATE
UNITED STATES ARMY ELECTRONICS
RESEARCH AND DEVELOPMENT COMMAND
FORT MONMOUTH, NEW JERSEY

PREPARED UNDER CONTRACT NO. DAAB07-77-C-0476

PREPARED BY

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ABSTRACT

Manufacturing methods and technology to establish production techniques for fabrication of stretched, oriented, polypropylene film armor that is both RF transparent and fragment resistant are to be developed.

Prototype processing technology and evaluation procedures developed by the Army Materials and Mechanics Research Center are to be revised for use in production facilities with mass production equipment.

Radome panels are to be constructed to demonstrate the mass production capabilities, confirm production rates, and establish mass production plans to meet estimated military needs.

The project is to consist of preliminary sample panel fabrication to confirm physical and electrical characteristics, a pilot production run to confirm production rates, and an in-plant demonstration of production capabilities.

Reports are to be provided on all phases of production development through the pilot run. In addition, production studies and planning necessary for expansion to a mass production basis are to be provided.

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1.0 PURPOSE AND INTRODUCTION

The purpose of this program is to establish production techniques and production capabilities for the manufacture of armor panels. The armor panels are intended for use with flat radar antennas to provide protection from munitions fragments.

The armor panels will be flat molded sheets of various sizes and edge finishes. The sheets will be molded from cross-plied assemblies of unidirectionally oriented, blown film made from a dielectric grade polypropylene. A protective overlay will be molded into the panel surfaces and camouflage will be incorporated in or onto a portion of the panels.

1.1 Program Description

The program is divided into four tasks as described below:

Task 1 Engineering Samples

Two sets of two each panels will be produced in order to demonstrate the ballistic capabilities of the selected materials and processes.

Task 2 Confirmatory Samples

Ten sets of two each panels of various sizes, thicknesses, and camouflaging methods will be produced in order to demonstrate the total capabilities of the panels in regard to environmental stability, electronic transmission, and ballistic characteristics. In addition, camouflaging techniques and panel trim and edge fusing will be demonstrated.

Task 3 Pilot Run

Thirty-two sets of two each panels will be produced in order to demonstrate the capacity of each production step and to verify the capability of the line to fabricate at an acceptable rate.

Task 4 Production Capability Demonstration

An in-plant demonstration will be held in order to show the production capabilities of the pilot production line to invited representatives of industry and government.

1.2 Reports

In addition to the quarterly report the following reports are to be provided during the course of the contract.

1) Engineering Sample Test Reports

   Mechanical and electronic test reports documenting engineering sample testing.

2) Confirmatory Sample Test Reports

   Mechanical and electronic test reports documenting confirmatory sample testing.

3) Preliminary Pilot Run Report

   A preliminary report on the capability of the pilot line.

4) Production Rate Flow Chart

   A description of the process, tooling, capacity, yield, and labor requirements of each operation of the pilot run.

5) Production Demonstration Plan

   A report to inform the industry at large of the activities and accomplishments of the program.

6) Final Report Step I

   Final engineering report covering project activities from start of the contract through pilot run panel fabrication and evaluation.

7) General Report Step II

   A report covering the manpower, facilities, equipment and tooling requirements necessary for a production rate of 200 units per 40 hour week.

1.3 Schedule

The program schedule for major events is presented in Figure 1.

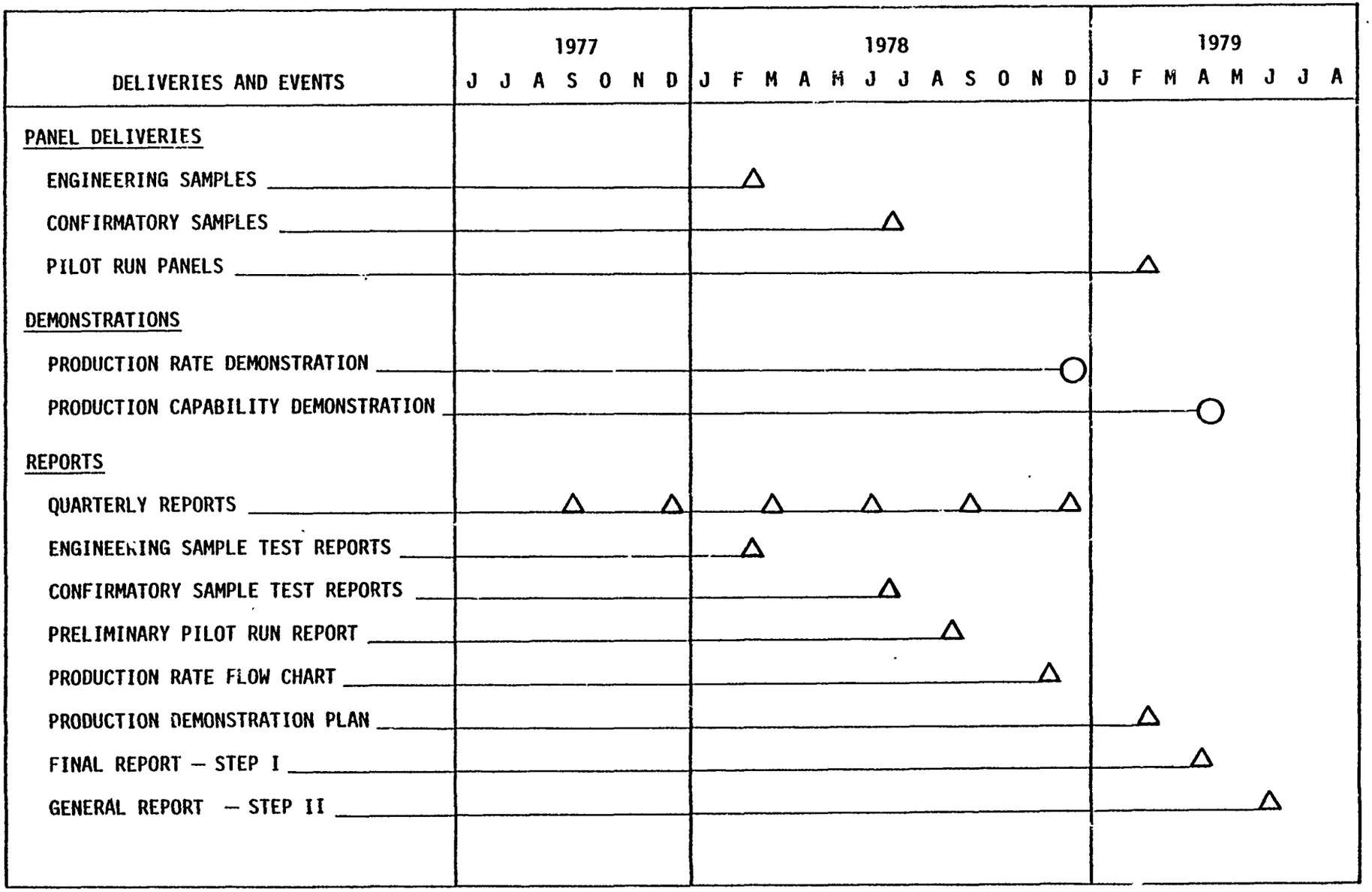


Figure 1. Program Schedule for Major Events

2.0 PANEL DESCRIPTION

2.1 Size and Configuration

Panels will be compression molded in a matched steel mold in two thickness with the same length and width. Nominal sizes are 1" x 32" x 42" and 3/8" x 32" x 42".

Different edge finishes will be provided by trimming and edge fusing molded panels.

Camouflage patterns will be provided by molding on printed film, attaching printed film with contact adhesive, and painting molded panels.

The following is a summary of panel configurations and sizes.

Size 1 - 1.045 ± .015 inch thick

Size 2 - 0.375 ± .015 inch thick

Finish 1 - Edge as molded. Panel size to be 32 ± .07 inch x 42 ± .07 inch

Finish 2 - Edge cut and fused. Final panel size to be 30 ± 1/32 inch x 40 ± 1/32 inch

Style 1 - Natural (protective film only - no camouflage)

Style 2a - Molded in camouflage

Style 2b - Contact adhesive applied camouflage

Style 2c - Painted camouflage

The panels will be made up of cross plied oriented polypropylene films drawn 12:1. Nominal oriented film size will be .0015 inches x 8 inches. Cross plying will be shoulder to shoulder, or butt wound as shown in Figure 2.

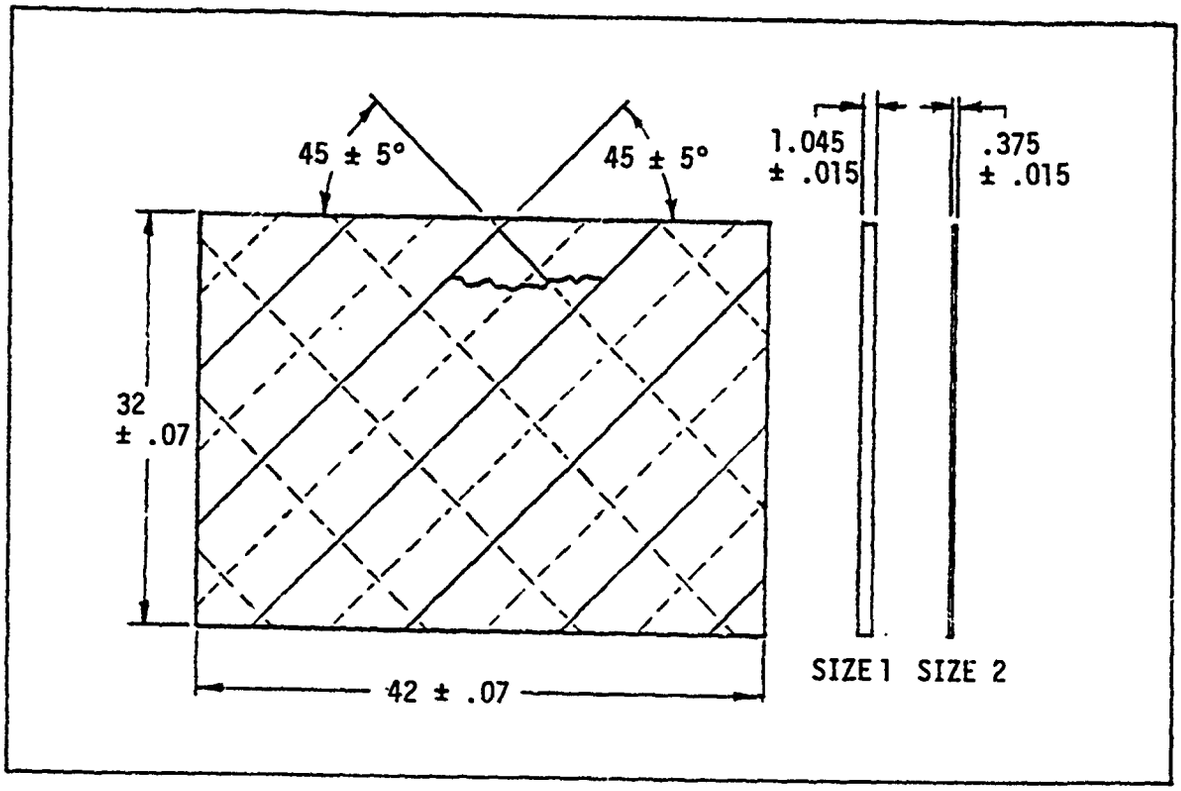


Figure 2. Cross-Plying

2.2 Schedule of Panel Fabrication

During the course of the program, the following panel configurations will be fabricated:

Engineering Samples - (4) Armor Panels

2 each Size 1, Style 1, Finish 1

2 each Size 2, Style 1, Finish 1

Confirmatory Samples - (20) Armor Panels

2 each Size 1, Style 1, Finish 1

2 each Size 1, Style 2a, Finish 1

Confirmatory Samples - Continued

2 each Size 1, Style 2b, Finish 1

2 each Size 1, Stype 2c, Finish 1

2 each Size 1, Style 1, Finish 2

2 each Size 2, Style 1, Finish 1

2 each Size 2, Style 2a, Finish 1

2 each Size 2, Style 2b, Finish 1

2 each Size 2, Style 2c, Finish 1

2 each Size 2, Style 1, Finish 2

Pilot Run - (64) Armor Panels

32 each Size 1

32 each Size 2

Style and finish to be determined after confirmatory sample evaluation.

Production Capability Demonstration

Quantity and configuration as required to demonstrate production methods.

3.0 MANUFACTURING PROCEDURE

The armor panel manufacturing procedure can be divided into four major processing steps.

Step 1	Extrude and orient polypropylene film
Step 2	Cross-ply film, assemble, and trim
Step 3	Precondition assembly, mold panels, and post condition panels
Step 4	Trim and edge fuse or apply camouflage as required

Figure 3 shows the detailed manufacturing steps needed to fabricate panels of various edge finishes and styles as a flow diagram.

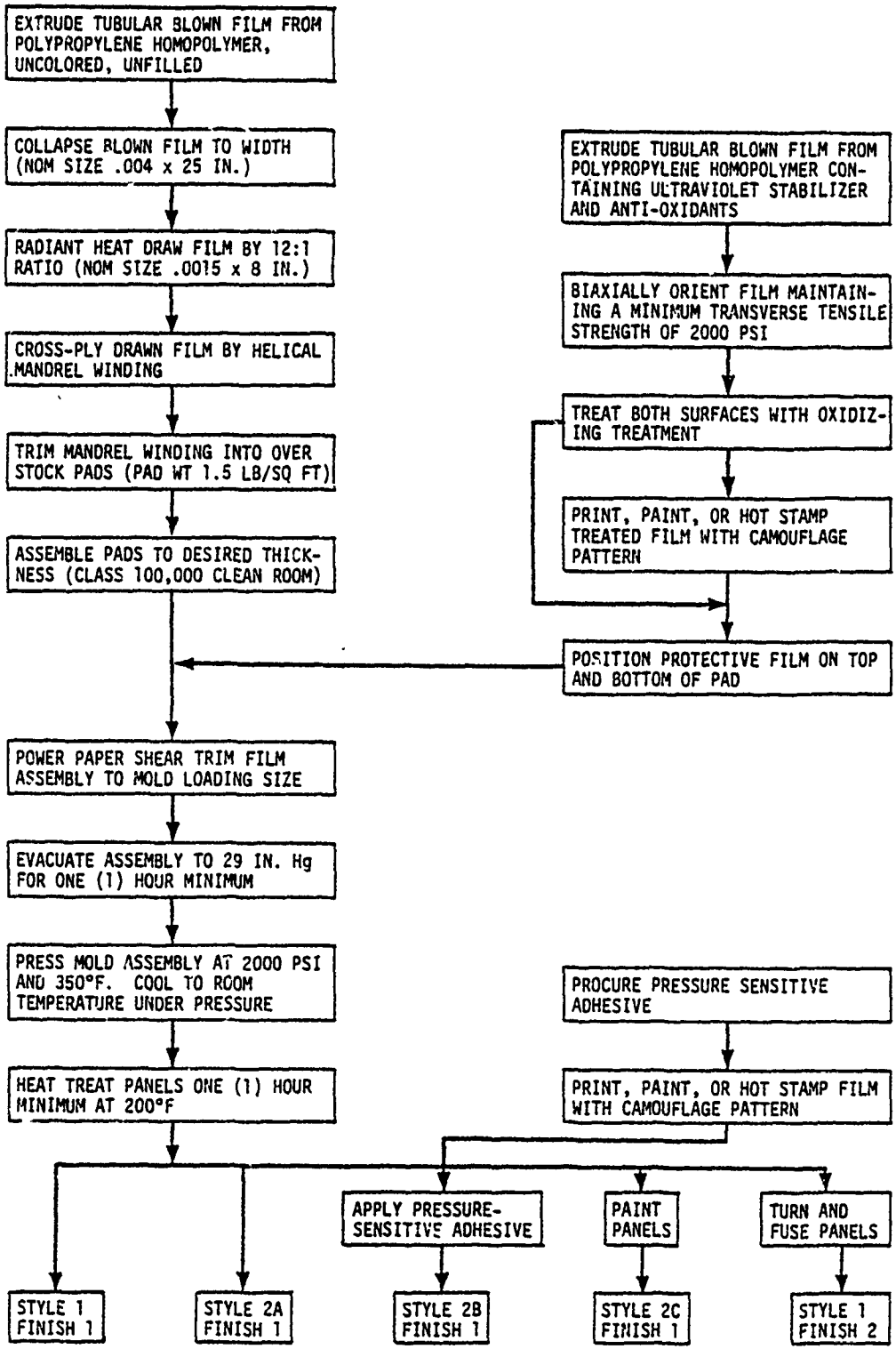


Figure 3. Manufacturing Flow Diagram

4.0 INSPECTION AND TESTING PROCEDURES

The primary inspection and testing tasks involve the ballistic, electronic, and dimensional stability testing of the completed armor panels. However, all raw materials that make up these panels will be subjected to physical and electrical testing.

All armor panels will be tested for frequency characteristics, sizes, and tolerances, edge finish and soundness (non-destructive tests).

Tests for camouflage and dimensional stability will be performed on one of each size – style – finish combination and ballistic tests will be performed on the other panel of that set (destructive tests).

Table I lists tests required and requirements for all component materials.

Table II lists tests required and requirements for armor panels. Tests are to be performed on engineering samples, confirmatory samples and pilot run panels.

TABLE I. COMPONENT MATERIAL TEST REQUIREMENTS

MATERIAL	TESTS REQUIRED	TEST PROCEDURE	REQUIREMENTS
1) Basic Materials			
Polypropylene resin	Physical properties	ASTM D 2146-69	Per ASTM D 2146-69
	Dielectric constant	ASTM D 2520-70	2.3 or less
	Loss tangent	ASTM D 2520-70	0.0005 or less
Protective overlay	Physical properties	ASTM D 2673-69	Per ASTM D 2673-69 and minimum transverse tensile strength of 2000 psi
	Accelerated weathering	FED-STD-191 Method 5804 for 200 hours	Retention of 90 percent of tensile strength and elongation
Protective overlay with camouflage	Physical properties	ASTM D 2673-69	Per ASTM D 2673-69 and minimum transverse tensile strength of 2000 psi
	Accelerated weathering	FED-STD-191 Method 5804 for 200 hours	Retention of 90 percent of tensile strength and elongation
	Camouflage	MIL-E-52798 and sample pattern	Per MIL-E-52798 and sample pattern
Pressure-sensitive adhesive coated film	Tensile strength and elongation	FED-STD-101 Method 2063	Tensile strength of 30 lbs per inch of width and 500 percent elongation minimum
	Adhesive strength	FED-STD-101 Method 2050	30 ounces per inch of width minimum
Paint	Camouflage	MIL-E-52798	Per MIL-E-52798

TABLE I. COMPONENT MATERIAL TEST REQUIREMENTS (Cont) Sheet 2 of 2

MATERIAL	TESTS REQUIRED	TEST PROCEDURE	REQUIREMENTS
2) Intermediate Materials			
Tubular blown film	Thickness	ASTM D 374-74 Method C	0.0044 ± .0004 inch
	width	Standard	Range of 24 to 27 inches, tolerance ± 1/4 inch
Oriented films	Orientation release stress	ASTM D 1504-70	1900 psi minimum average 1700 psi minimum individual
	Temperature of maximum stress	ASTM D 1504-70	345°F minimum average 340°F minimum individual
	Thickness	ASTM D 374-74 Method C	.0015 maximum average .0020 maximum individual
	Width	Standard	None - record
	V_{50} Ballistic Limit	MIL-STD-662A	(Classified)

TABLE II. ARMOR PANEL TEST REQUIREMENTS

MATERIAL	TEST REQUIRED	TEST PROCEDURE	REQUIREMENTS
1) Non-destructive Tests			
All panels	Size & tolerance	Standard	Size 1 Finish 1 .375 ± .015 x 32 ± .07 x 42 ± .07 Size 2 Finish 1 1.045 ± .015 x 32 ± .07 x 42 ± .07 Size 1 Finish 2 .375 ± .015 x 30 ± .032 x 40 ± .032 Size 2 Finish 2 1.045 ± .015 x 30 ± .032 x 40 ± .032
	Edge finish	Standard	No splits, delaminations greater than .060, or raised lips greater than .030
	Soundness	Standard	Translucent and free of edge splits, voids, unbonded areas, and blisters
	S-Band Frequency Characteristics	(Classified)	(Classified)
2) Destructive Tests			
One panel of each size - style - finish set	Dimensional stability	Humidity cycle in test chamber (60 Hrs. total) Per PD-105 Section 4.2.5	No splits or delaminations. Maximum length or width change 0.40 inch decrease. Maximum thickness change 0.010 inch increase. Maximum change in warpage 0.06 inch increase.

TABLE II. ARMOR PANEL TEST REQUIREMENTS (Cont)

MATERIAL	TEST REQUIRED	TEST PROCEDURE	REQUIREMENTS
2) Destructive Tests Continued			
	Camouflage	MIL-E-52798 and standard sample	Per MIL-E-52798 and standard sample
Other panel of each size - style - finish set	V_{50} Ballistic Limit	MIL-STD-662A	(Classified)
One specimen of each style molded to dimensions required following panel procedure including, except for style 1, the incorporation of camouflage	Dielectric constant at 50 ± 5 percent relative humidity	ASTM D2520-70	2.3 or less
	Loss factor at 50 ± 5 percent relative humidity	ASTM D2520-70	0.0005 or less

5.0 TOOLING AND PROCESSING EQUIPMENT

5.1 General Description

Manufacture of the armor panels involving a series of processing steps through various types of processing equipment that function independently or in conjunction with specific armor tools.

The multi-purpose processing equipment such as film extruders, presses, and ovens are capitalized equipment that have various and continuing manufacturing uses.

The armor tooling is designed specifically for armor panels processing.

Figure 4 shows a schematic flow of the armor through the processing equipment and special tools.

5.2 Armor Tooling

The following is a brief description of the armor tooling describing the intended use and special tooling features.

Anti-Static Attachment

The anti-static device consists of two bar type static eliminators mounted just forward of the mandrel winding take-off film roll and positioned on either side of the oriented film.

These units will neutralize the static charge on the film and prevent the pick up of dust or any other floating air contaminates.

Caul Plates

The caul plates are .050 thick stainless steel plates that are placed on either side of the assembled cross-plied film either just before or just after trimming to net size for molding.

The caul plates help hold the cross-plied material in position during evacuation and mold loading. They are removed from the part after molding and cool-down.

Power Shear

The power shear is a standard power paper shear modified for special hold down requirements for plastic film shearing.

The power shear cuts the assembled, cross-plied film to net molding size.

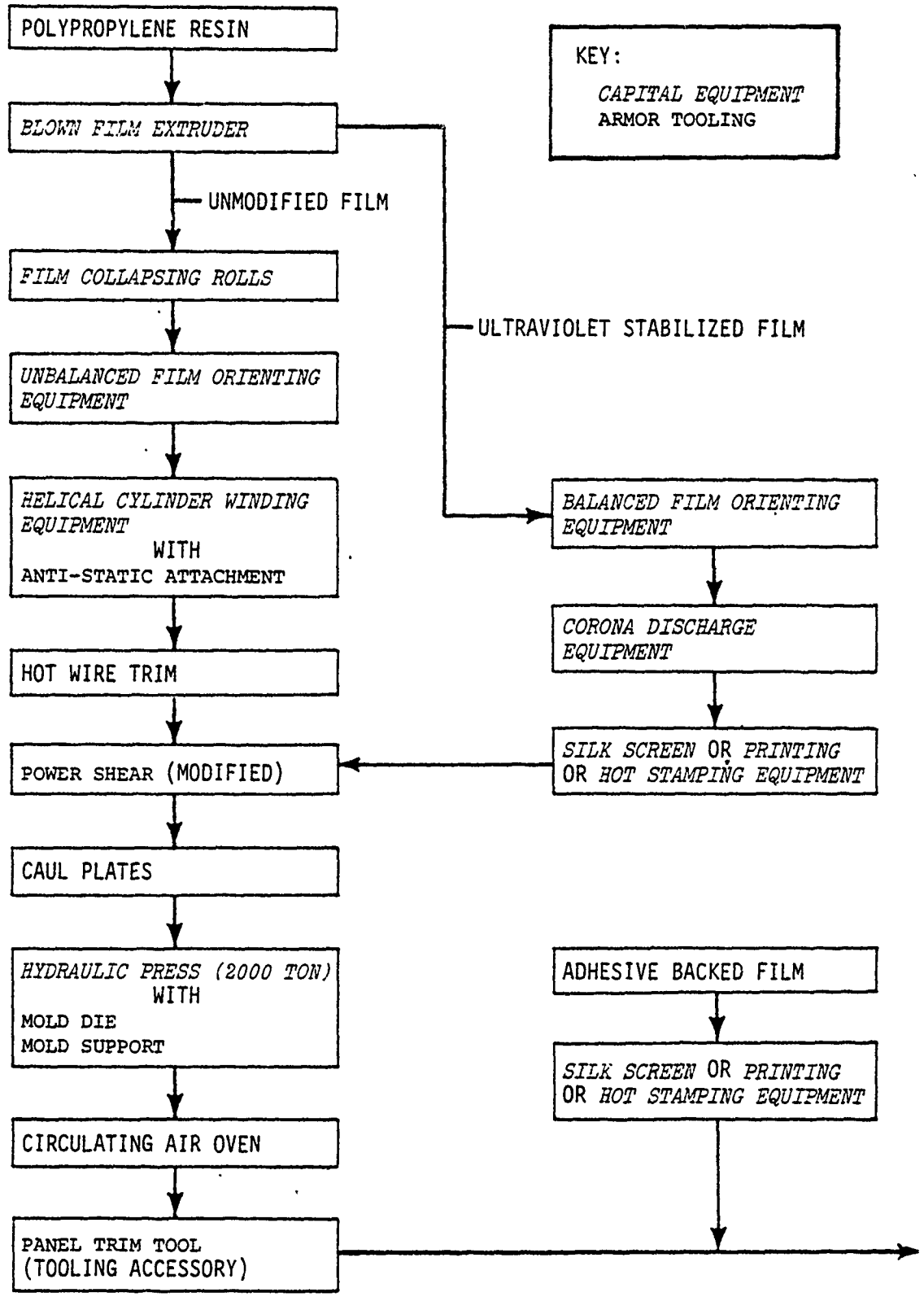


Figure 4. Tooling and Processing Equipment Flow Chart

Mold Die

The mold die is a matched steel die used to contain the cross-plied assembly during the lamination cycle. It is a semipositive compression mold with a steam heating — water cooling chamber on either side. It has guide pins and bushings for alignment and stop blocks for thickness control.

Figure 5 shows a sketch of the mold die. See Appendix A, Swedlow Drawing No. 77016 — Mold Die Assembly.

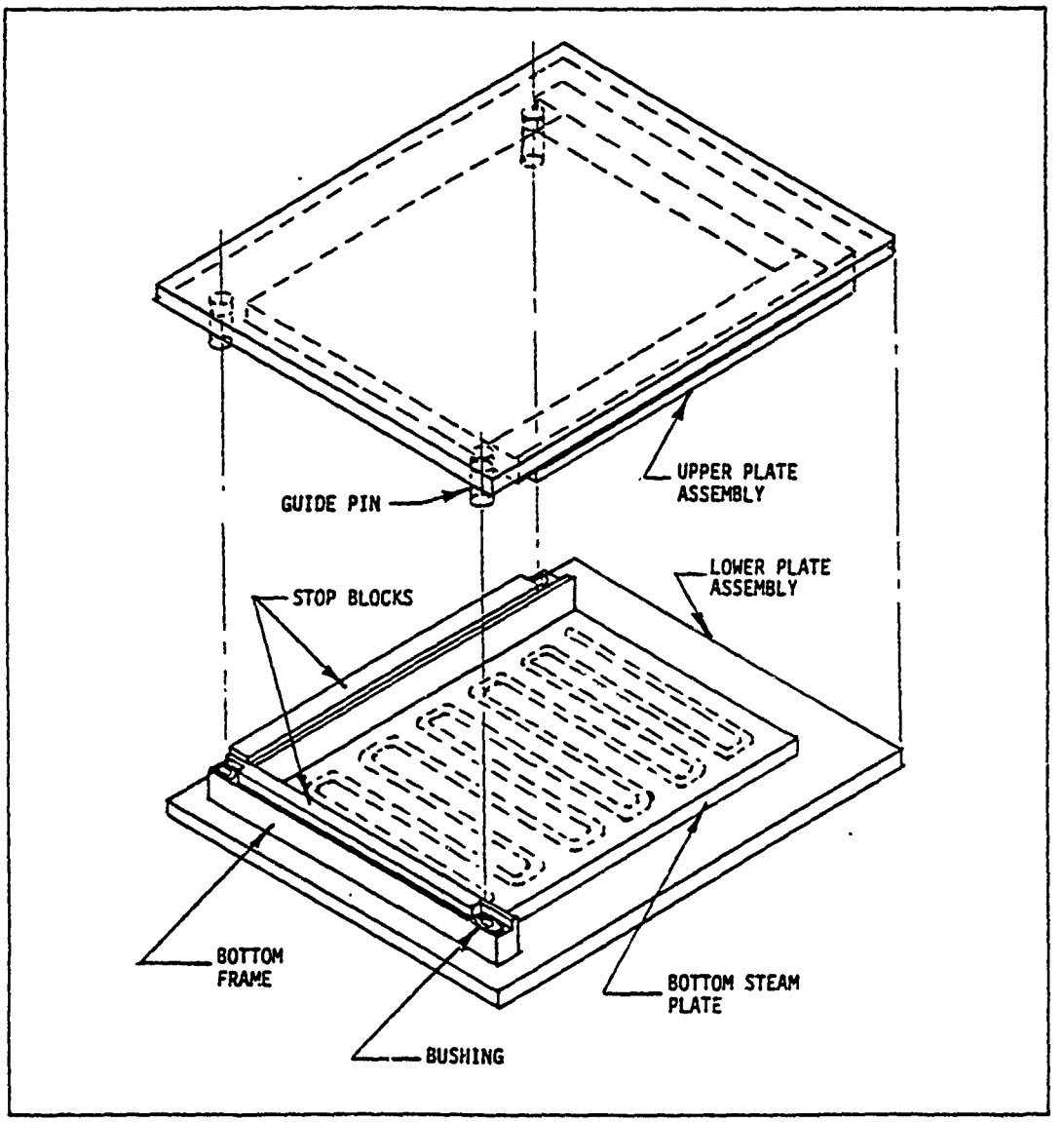


Figure 5. Mold Die Configuration

The mold die has the following features:

1) The top and bottom halves of the die are mirror images with all components of the same size and thickness. This provides for a balanced heat input and uniform cool-down.

2) The die containment frame is split between top and bottom die halves. This arrangement allows ease of loading and unloading without side frame removal.

   In addition, it accommodates loading of a bagged assembly shearing off the bag during mold close, as shown below in Figure 6.

3) The side bars are bolted and doweled onto the base plate. This arrangement allows for ease of die rework if length and width dimensional tolerances are not met.

   Stop block control of shut height also allows for ease of rework if thickness tolerances are not met.

4) The location and close spacing of the steam - water passages will provide rapid and uniform heat-up and cool-down.

5) All working surfaces will be chrome plated for corrosion resistance.

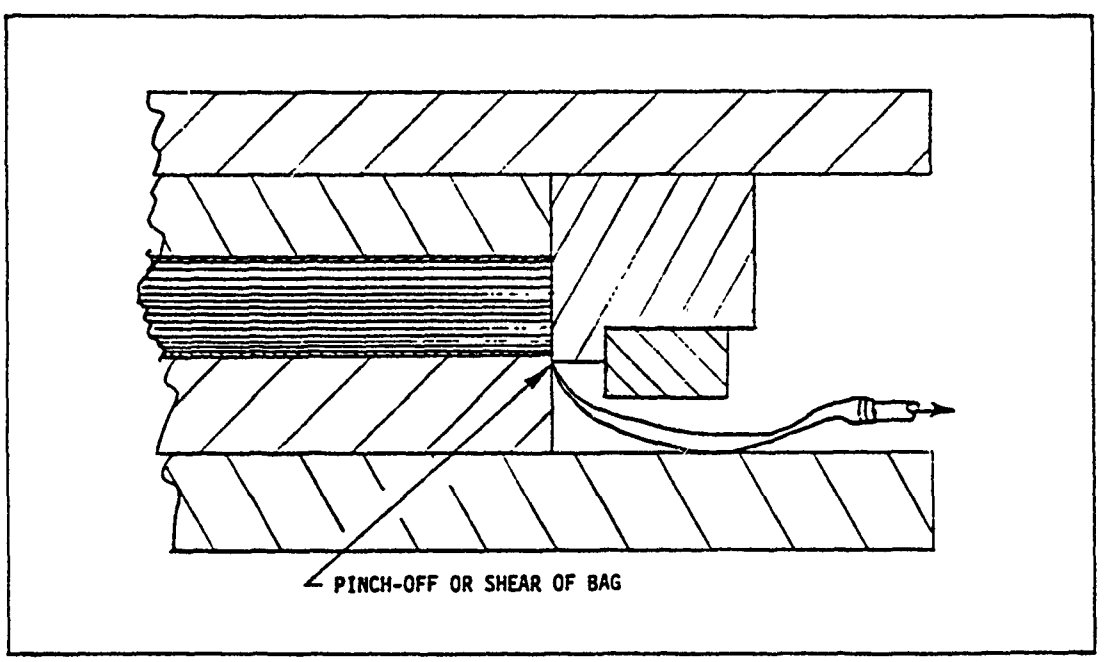


Figure 6. Shearing Off the Bag

Mold Support

The mold support is a steel weldment needed in order to achieve full press closure. See Appendix A, Swedlow Dwg No. 77013 — Mold Support.

Panel Trim Tool

The panel trim tool will consist of a hold down frame to firmly restrain the panel during final trim and fusion.

Other Accessory Tools

Other accessory tools will be handling and holding aids, as needed, at the various processing steps.

6.0 PROBLEM AREAS AND PROPOSED SOLUTIONS

Problem areas and potential problem areas along with proposed solutions are discussed in the following paragraphs.

6.1 Discontinuance of Manufacturing of Previously Tested Polypropylene Homopolymer

The basic polypropylene resins used in the preliminary AMMRC laboratory-scale and prototype testing programs has been discontinued by the manufacturer Phillips Chemical Co. The successor of this film has not as yet been fully evaluated to assure completely satisfactory processing, physical, and electronic characteristics.

Solution:

The program has been rescheduled to allow sufficient time for evaluation of the successor film.

6.2 Film Contaminates and Moisture Pick-up

As contaminates and moisture pick-up would result in poor bonding and subsequent delaminations during dimensional stability testing, special precautions for their prevention and elimination are required.

Solutions:

Materials will be packaged and stored in such a manner so as to prevent contamination and moisture pick-up between processing steps.

Anti-static bars will be used to neutralize the static charge on the film at the winding operation and thus prevent pick-up of floating contaminates.

All film handling will be done with clean dry cotton gloves.

Assembly of the film will be done in a Class 100,000 or better clean room.

Polypropylene film plies that come into contact with protective covers or separators will be removed and discarded.

Moisture pick-up problems will be eliminated by heating the assembly during evacuation prior to molding.

Air Entrapment

As air entrapment will also result in poor bonding and degradation of both physical and electronic properties, effective evacuation procedures must be developed. At the same time excessive evacuation time in the mold die will tie up a major piece of processing equipment and increase the duration of a critical processing step.

Initial laboratory work by AMMRC indicates that air entrapment can not be eliminated without an evacuation procedure.

Using the philosophy of proceeding from the simple to the more complicated, the following processing methods will be tried sequentially.

Solutions:

1) The assembly will be vacuum bagged and evacuated for 15 hours minimum prior to molding. The assembly will be removed from the vacuum bag just prior to loading into the mold.

2) The assembly will be bagged and evacuated for 15 hours minimum prior to molding. The bagged assembly will then be loaded into the mold and the vacuum maintained as the mold closes and shears off the bag (see Figure 6).

3) The assembly will be vacuum bagged and evacuated for 15 hours minimum prior to molding. The assembly will be removed from the vacuum bag just prior to loading into the mold die. The assembly will then be re-evacuated in the mold die and held for one-half hour minimum prior to mold closure and during closure and cure.

Delamination During Panel Trimming

As trimming finished panel edges without inducing delamination is difficult, special tooling, equipment and procedures will be required.

Solution:

A high pressure hold down system will be developed to prevent delamination during trimming and fusion operations.

7.0 ACCOMPLISHMENTS DURING THIS QUARTER (June, July, August, 1977)

Accomplishments during the first three months are outlined below.

7.1 Program Review and Revision

A review of the program covering materials, processing, and testing requirements was completed this period.

During the review of material requirements, the problem of the untested successor to the previously manufactured polypropylene resin surfaced. The schedule was revised to allow sufficient time to evaluate the successor material.

The review information was formalized into a PERT schedule (Program Evaluation and Review Techniques). The PERT schedule has been revised to reflect the above schedule change (see Appendix B - PERT Chart Revision "A").

7.2 Facilities, Equipment and Manpower Evaluation

The facilities, equipment and manpower requirements of the program were analyzed and all program requirements were scheduled.

7.3 Major Tool Design and Fabrication

The major tools including the mold die and the mold support were designed and fabrication of these tools by outside vendors was started. See Appendix A, Swedlow Drawings No. 77013 and 77016.

7.4 Accessory Tool Design

The accessory tools with the exception of the final panel trim tool, handling and holding fixtures were designed and scheduled for fabrication.

7.5 Material and Process Evaluation

Material and/or processing method evaluation was started in the following areas.

a) Trim and edge fusion process development

b) Protective film selection

c) Adhesive backed film selection

d) Camouflage material selection

e) Camouflage material application process development

8.0 SCHEDULE FOR THE NEXT QUARTER (September, October, November, 1977)

The program schedule for the next three months is outlined below.

8.1 Oriented Film Processing and Delivery

The initial order of the oriented film is scheduled for delivery at the end of September. This will be sufficient material for film evaluation, process development, and for fabrication of the Engineering Sample Panels.

8.2 Oriented Film Evaluation

Evaluation of the oriented film for mechanical properties, electrical properties, electronic properties, and ballistic properties will be started as soon as the material is received.

This testing is scheduled for completion the first week in December.

8.3 Protective Film Processing and Evaluation

The protective film is scheduled to be run in October and evaluation will be started as soon as the film is received.

8.4 Major Tool Delivery

The mold die and mold support are scheduled for delivery at the end of October and will be inspected upon receipt.

8.5 Material Procurement

The balance of the oriented film and the total program order for cross-plied pads are scheduled for ordering in the last month of this period (November).

8.6 Material and Process Evaluation

The protective film, adhesive backed films, and camouflage materials selection and process development will be continued through the next three month period.

REFERENCES

REPORTS

1. Prifti, De Luca, and Alesi, "Hardened Tuned-Wall Plastic Radomes for Military Radars (U)", Army Materials and Mechanics Research Center, Watertown, Massachusetts.

2. Alesi, Ames, Gagne, Litman, and Prifti, "New Materials and Construction for Improved Helmets", Army Materials and Mechanics Research Center, Watertown, Massachusetts, AMMRC MS 75-9.

SPECIFICATIONS

AMMRC-PD-105	Technical Requirements Armor, Panel, Polymeric, Radar, Antenna Hardening
ECIPPR No. 15	Manufacturing Methods and Technology (MM&T) for Components, Materials and Processes
MIL-E-52798	Enamel, Alkyd, Camouflage

STANDARDS, MILITARY AND FEDERAL

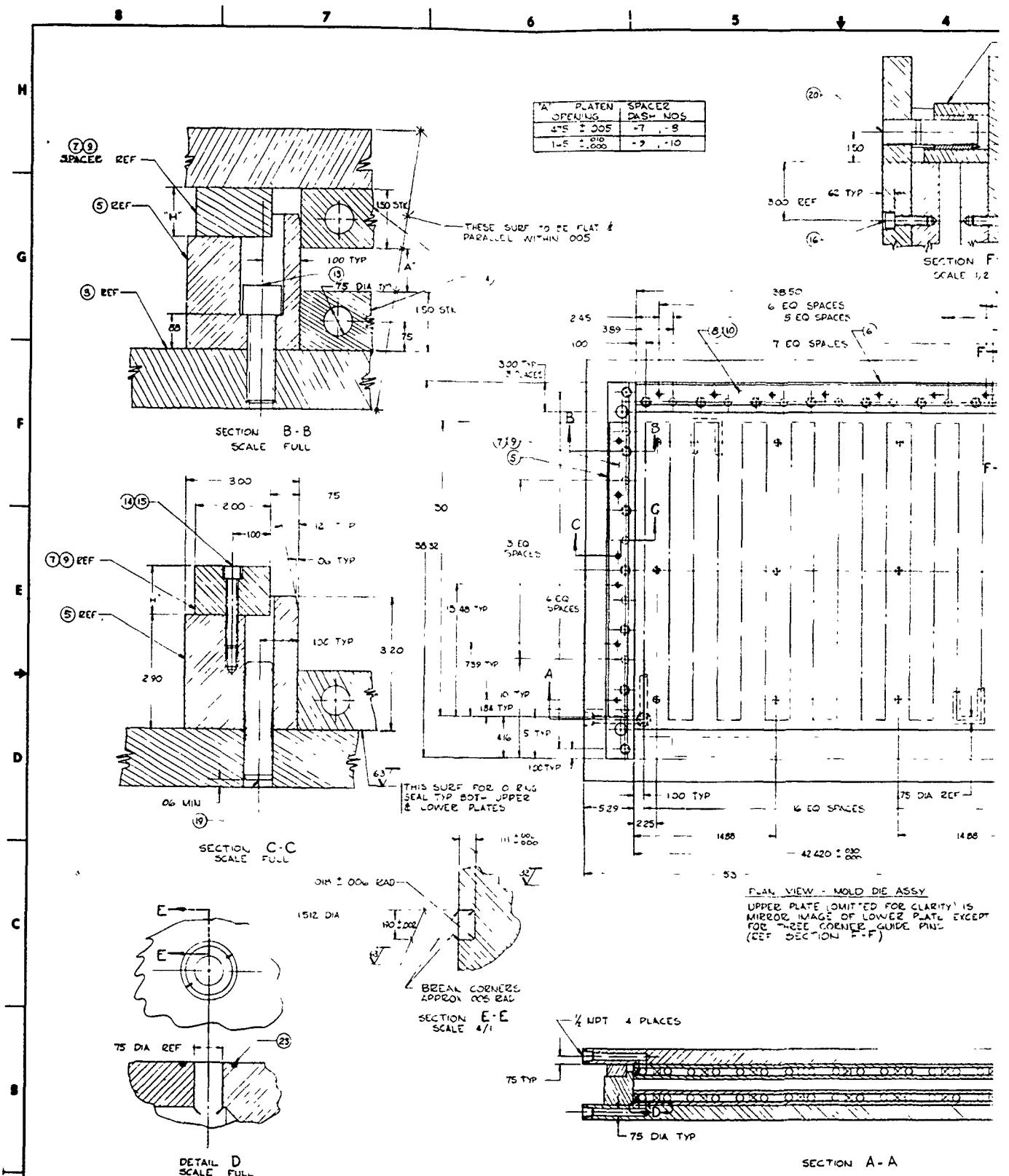
MIL-STD-662	Ballistic Acceptance Test Method for Personnel Armor
FED-STD-101	Preservation, Packaging and Packing Materials, Test Procedures
FED-STD-191	Textile Test Methods

STANDARDS, INDUSTRY

ASTM D 374-74	Thickness of Solid Electrical Insulation
ASTM D 1504-70	Determining Orientation Release Stress of Plastic Sheeting
ASTM D 2146-69	Propylene Plastic Molding and Extrusion Materials
ASTM D 2520-70	Complex, Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials at Microwave Frequencies and Temperatures to1650°C
ASTM D 2673-69	Oriented Polypropylene Film

APPENDIX A

DRAWINGS



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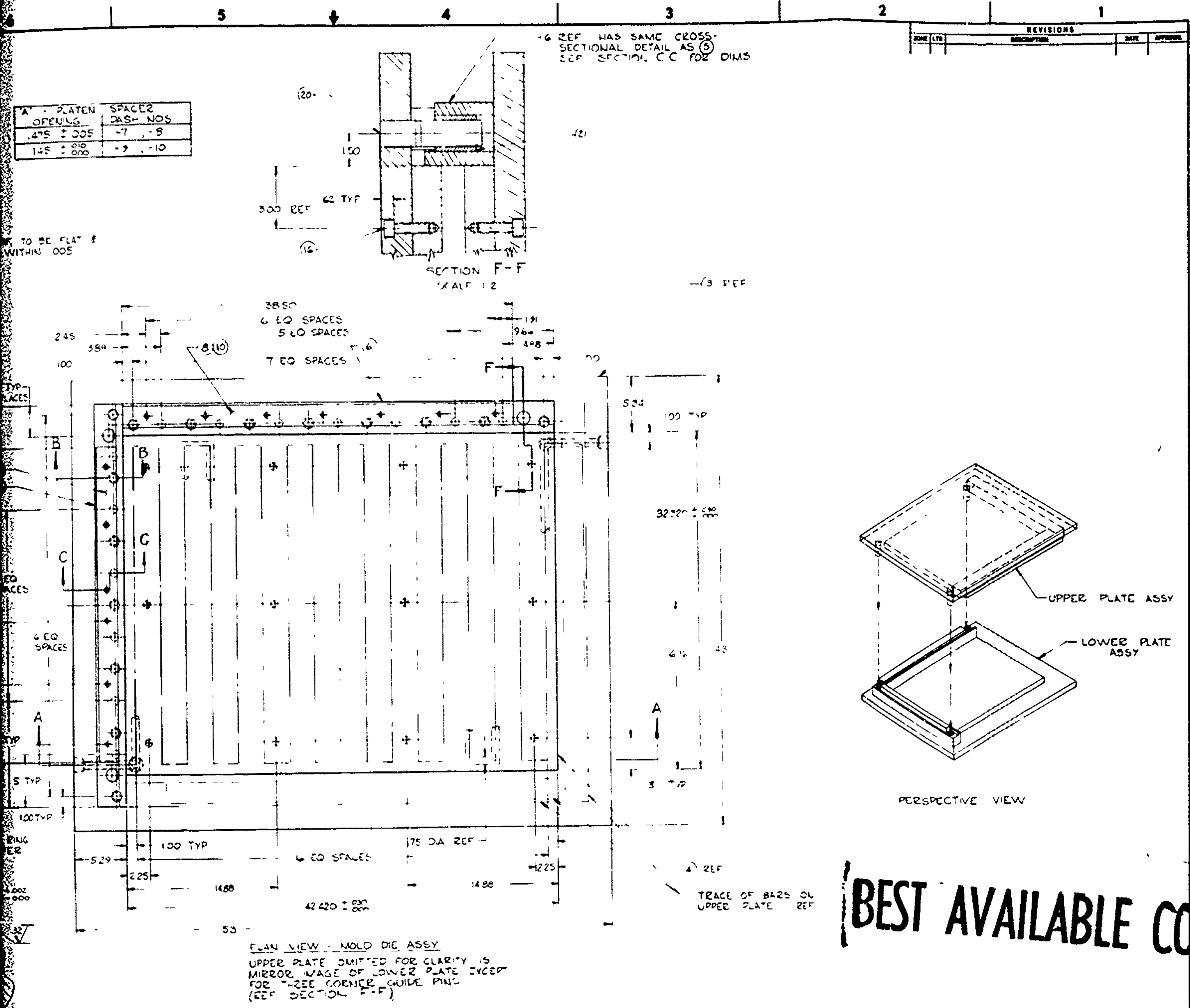
5. FLASH CHROME DETAILS -4,-5,-6,-7,-8,-9,-10
4. MOLD SHUT OFF CLEARANCE .010 ± 005
3. SUGGESTED SOURCE PARKER SEAL CO.
2. SUGGESTED SOURCE: DANLY MACHINE SPECIALTIES, INC.
1. BREAK ALL SHARP EDGES

NOTES:

A-1



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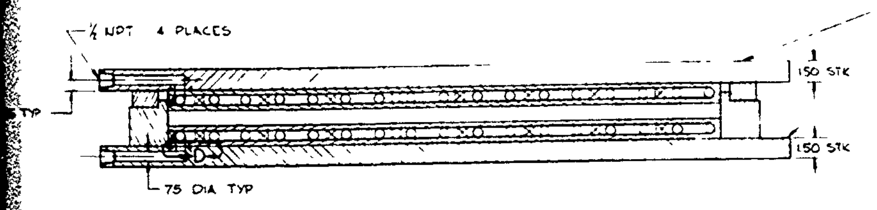

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-2	-1	ITEM NO.	PART NO.	DESCRIPTION		MATL
		24				
	4	23	2-216 E540-80	ETHYLENE PROPYLENE "O" RING		(3)
		22				
	3	21	6-10-1	1¼ ID × 1¾ OD × 2 LG BUSHING		(2)
	3	20	5-1020-1	1¼ DIA × 5 LG GUIDE POST		(2)
	24	19	72448-1	½ DIA × 3 LG DOWEL PIN		(2)
		18				
		17				
	24	16	½-13 × 1½ LG	SOCKET HEAD CAP SCREW		
	26	15	5/16-18 × 1 LG			
26		14	5/16-18 × 1¾ LG			
	30	13	¾-10 × 2¼ LG	SOCKET HEAD CAP SCREW		
		12				
		11				
2		10	-10	STOP BLOCK		CRS
2		9	-9			
	2	8	-8			
	2	7	-7	STOP BLOCK		CRS
	2	6	-6	EDGE BAR		HRS
	2	5	-5	EDGE BAR		
	2	4	-4	STEAM PLATE		
	2	3	-3	BASE PLATE		HRS
X	-	2	77016-2	MOLD DIE CONV. DET (1.145 THK)		
-	X	1	77016-1	MOLD DIE ASSY - (.475 THK)		

QUANTITY REQUIRED

LIST OF MATERIAL

APPLICATION

SWEDLOW, INC.

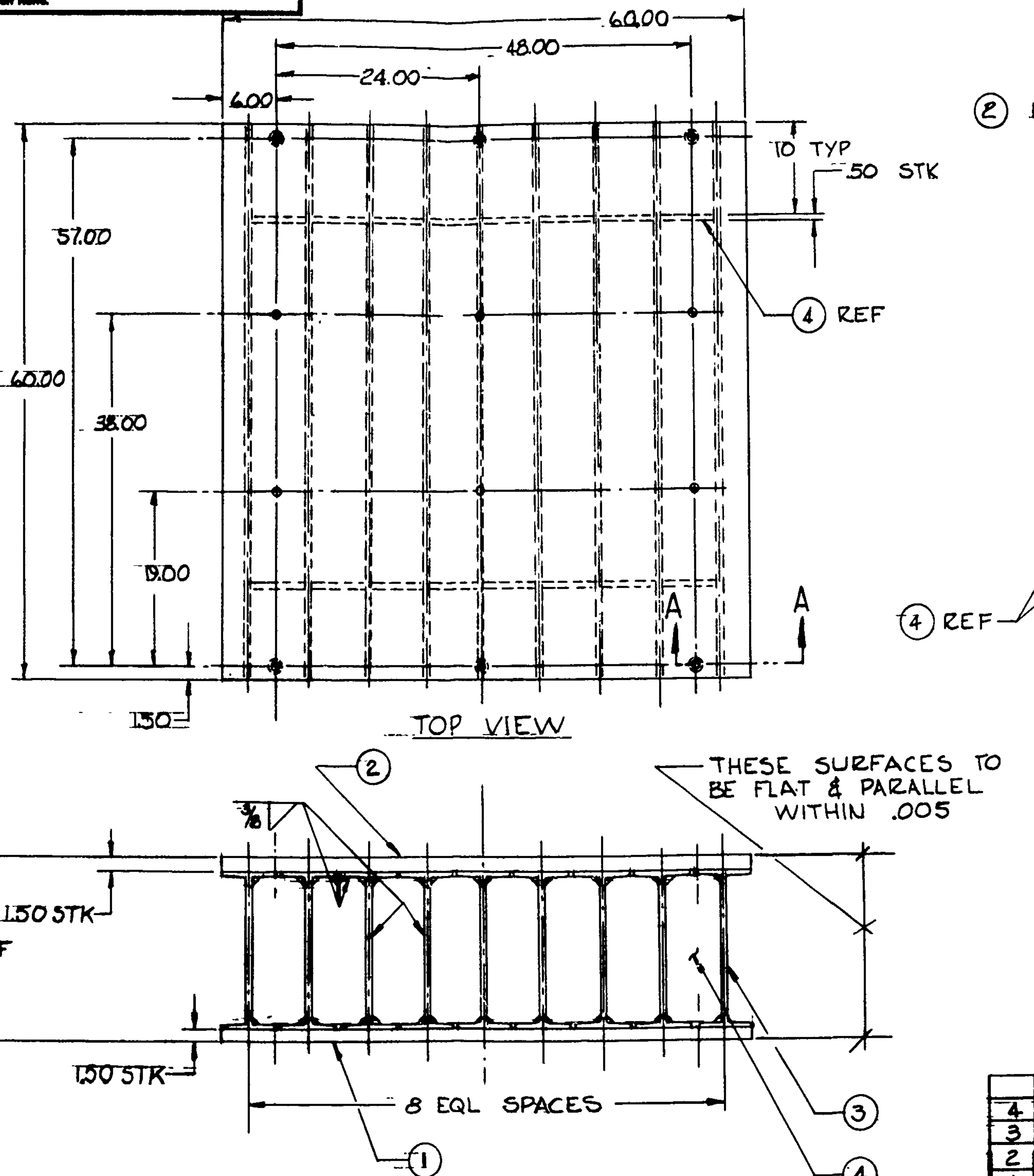
MOLD DIE ASSY

DRAWN J.J.K. 7-24-77
CHECKED R. DOPPE 7-27-77

SIZE E

DRAWING NO. 77016

2



3. BREAK ALL SHARP EDGES

2. PAINT EXTERIOR EXCEPT GROUND SURFACES WITH TEMP RESISTANT PAINT (GRAY OR GREEN)

1. STRESS RELIEVE WELDMENT BEFORE GRINDING

NOTES:

NOTES: UNLESS OTHERWISE SPECIFIED

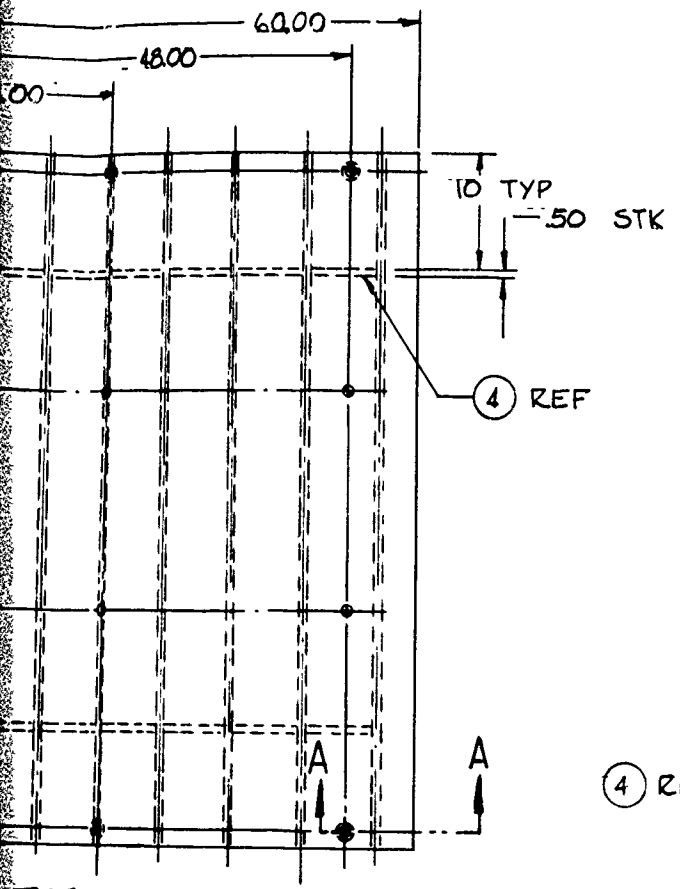
NEXT ASSY	USED ON
APPLICATION	

DO NOT SCALE DRAWING

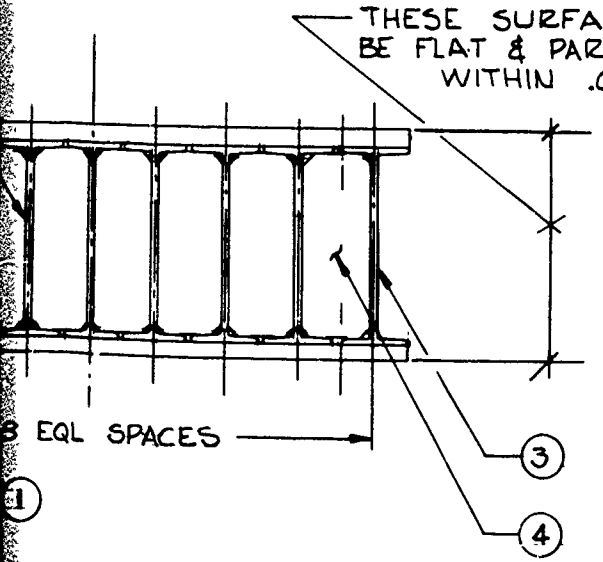
MATERIAL

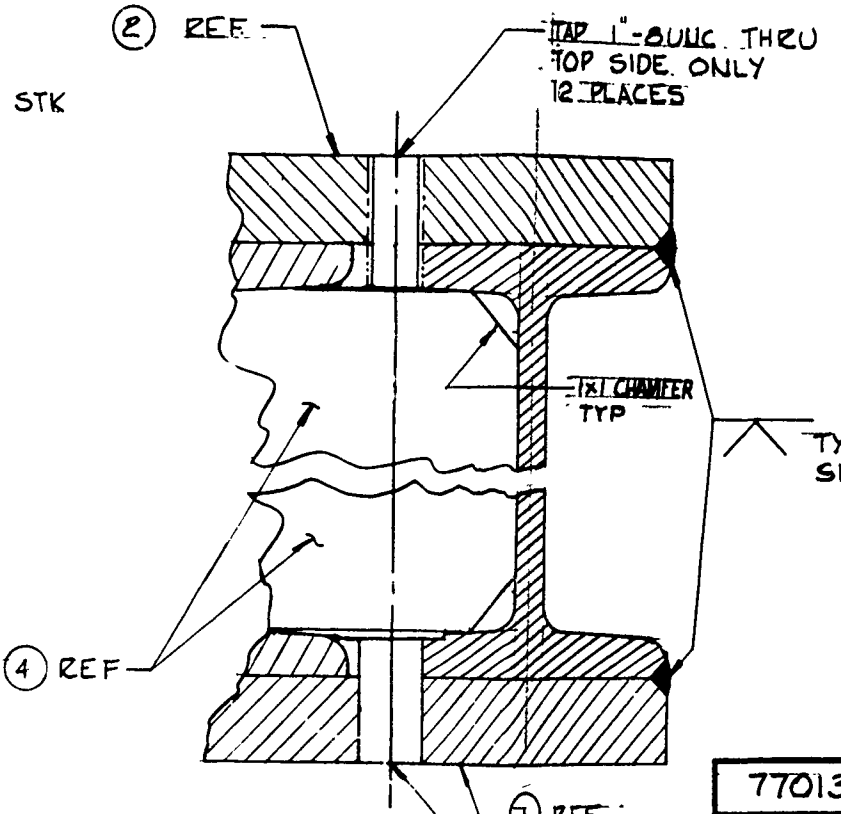
FIND NO.
4
3
2
1

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL



TOP VIEW





SECTION A-A
SCALE 1/2

77013

FIND NO.	REQD	PART NO.	DESCRIPTION	MATL	MATL SPEC	UNIT WT
4	16	-4	1/2 x 5 15/16 x 17 7/8 PLATE	MILD STL		15.5
3	9	-3	18" x 6 1/4 x 70 7/8" I BEAM			350
2	1	-2	PLATE, 1 1/2 x 60 x 60			1620
1	1	-1	PLATE, 1 1/2 x 60 x 60	MILD STL		1620

LIST OF MATERIAL

D SURFACES
RAY OR GREEN)
EFORE

NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES: FRACTIONS ± 1/64; DECIMALS .XX ± .02, .XXX ± .010; ANGLES ± 0°30'. DO NOT SCALE DRAWING.

MATERIAL

DRAWN BY J.J.K. 7/11/77
CHECKED R.DOERR 7/18
APPROVED
FINISH

DRAWING SIZE C

MOLD SUPPORT

SCALE 1/8 & NOTED

SWEDLOW Inc.
LOS ANGELES, CALIFORNIA
GARDEN GROVE, CALIFORNIA

77013

CODE

SHEET 1 OF 1

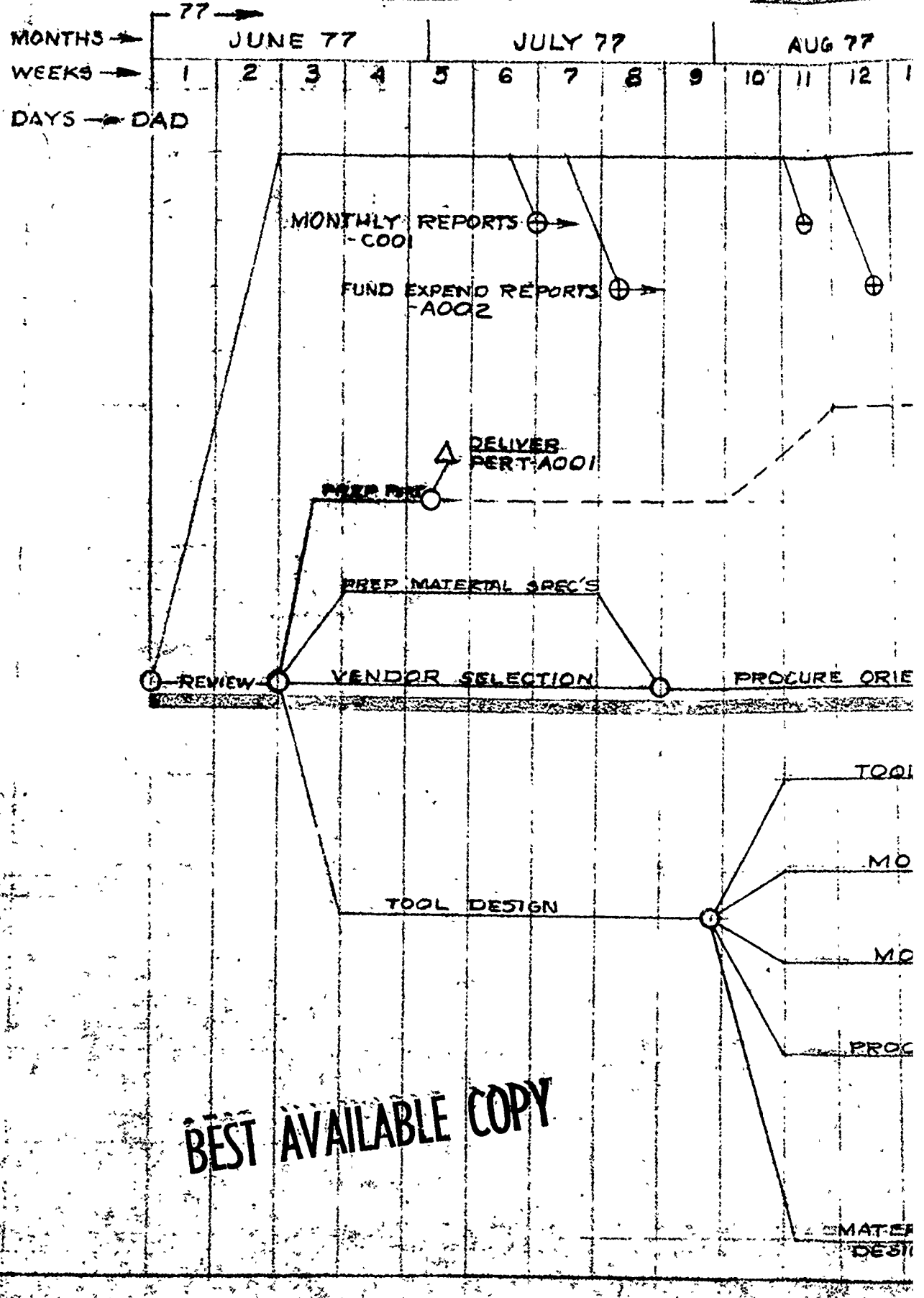
APPENDIX B

PERT CHART, REVISION A

APPENDIX B

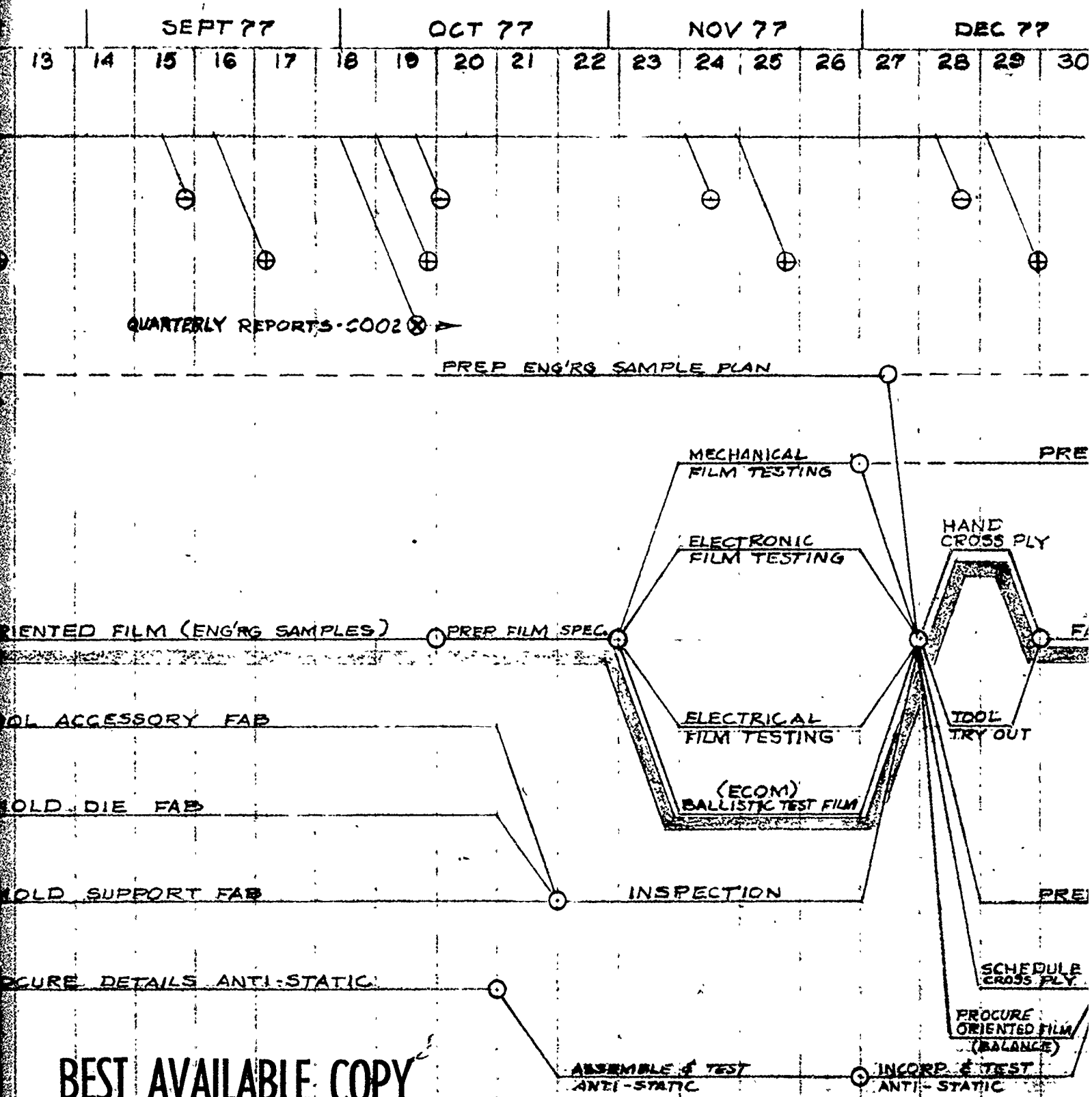
PERT CHART

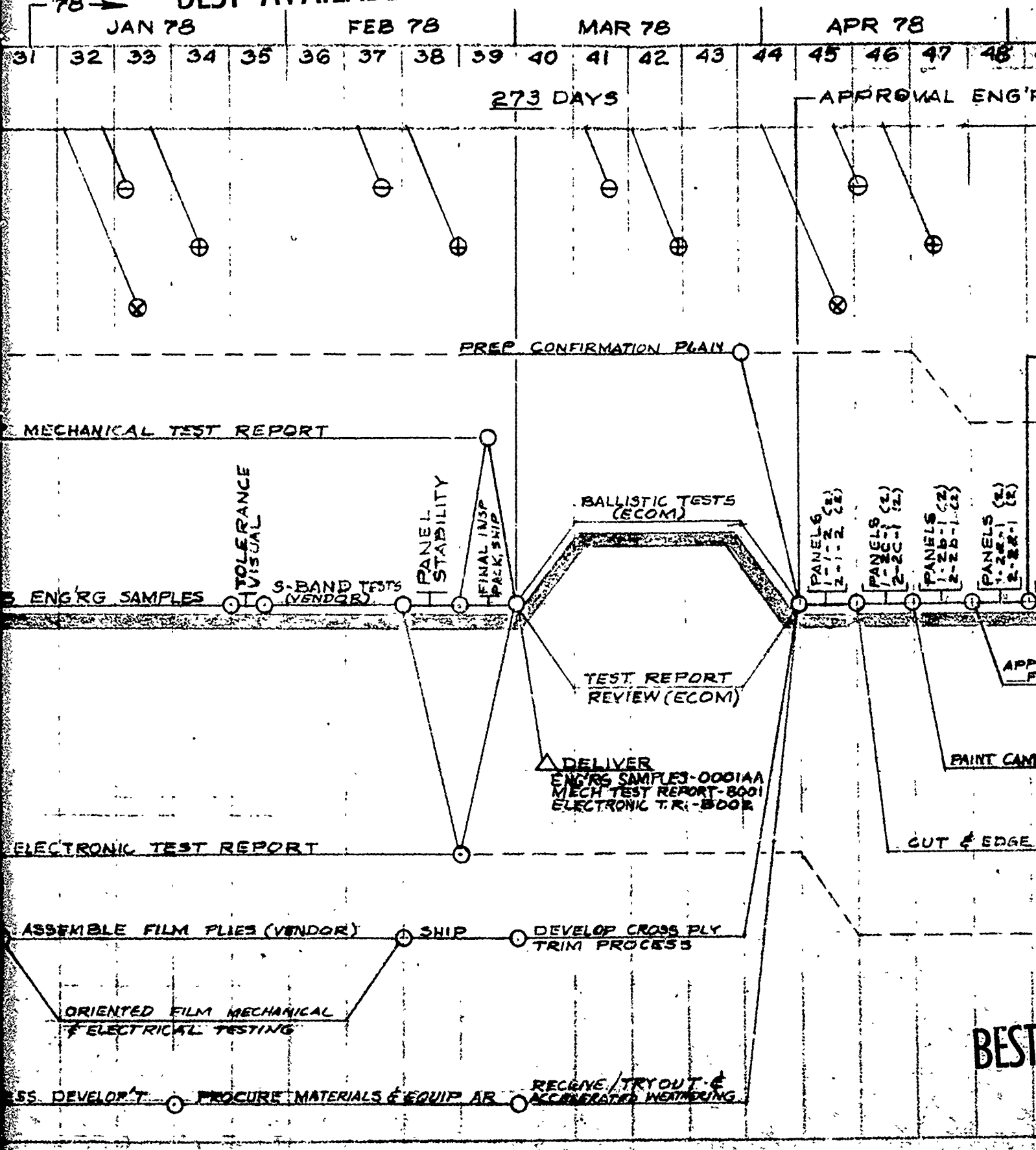
CONTRACT N

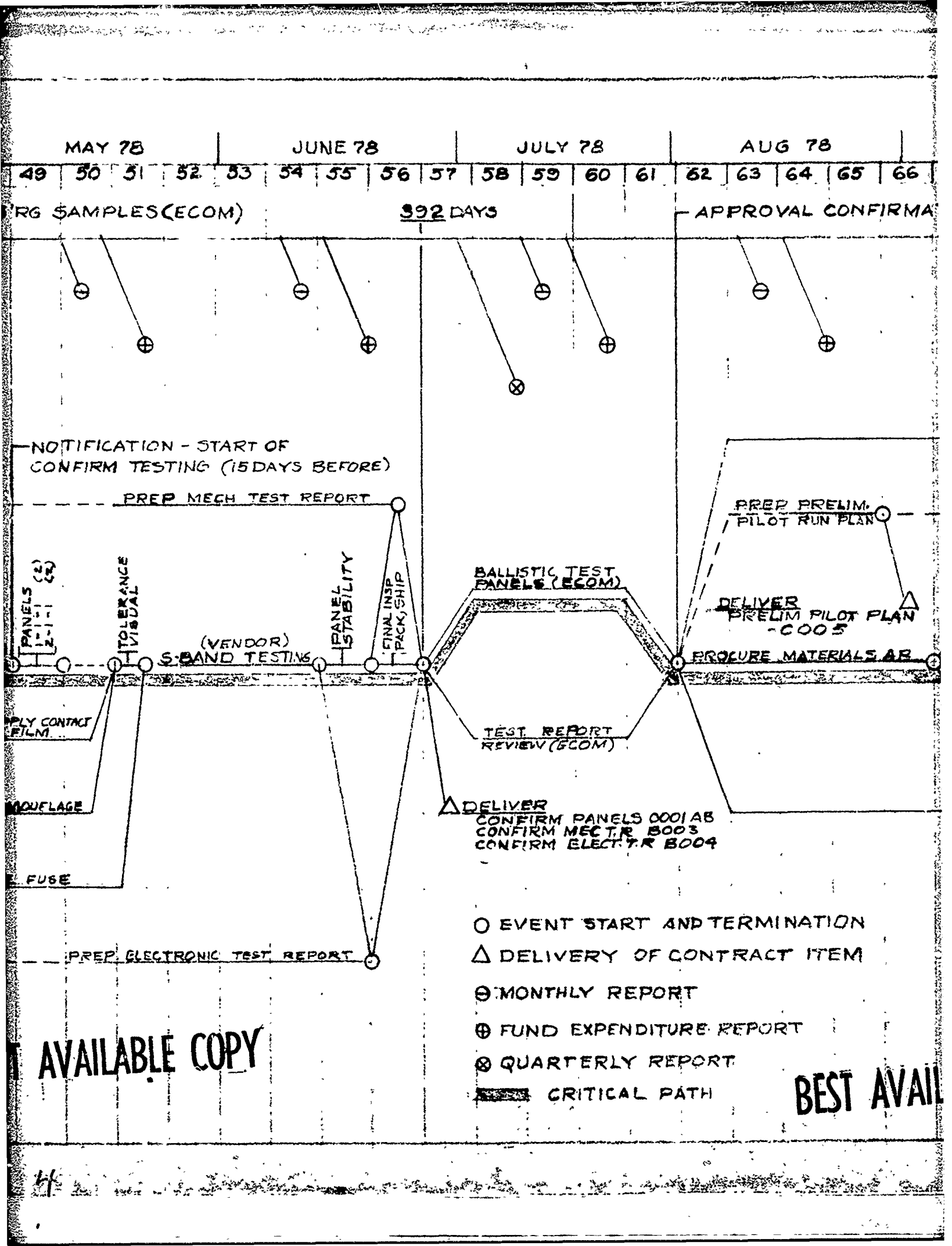


REV A

T NO DAA B07-77-C-0476 USAEC R DOERR 6-24-77







SEPT 78 | OCT 78 | NOV 78 | DEC 78

66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83

RMATION PANELS - STYLE & FINISH FOR PILOT RUN (ECOM)

PREP FINAL REPORT STEP I

PREP RATE FLOW CHART — PREPARE PRODUCT

TEST MATERIALS

DELIVER RATE DEMO FLOW CHART (10 DAYS BEFORE DEMO)

TOLERANCE, VISUAL

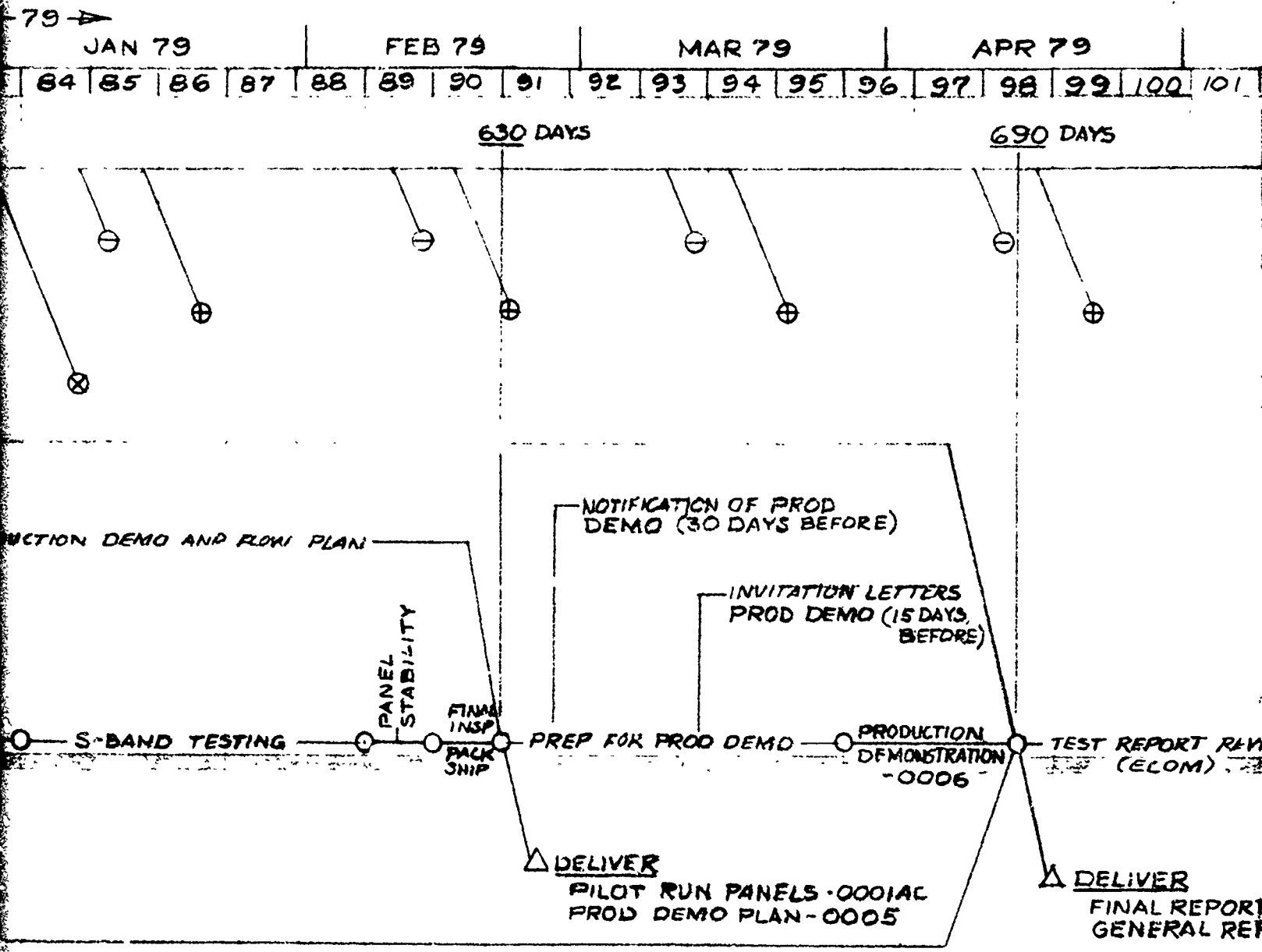
FAB PILOT RUN PANELS — VERIFICATION PROD RATE

REC INSP

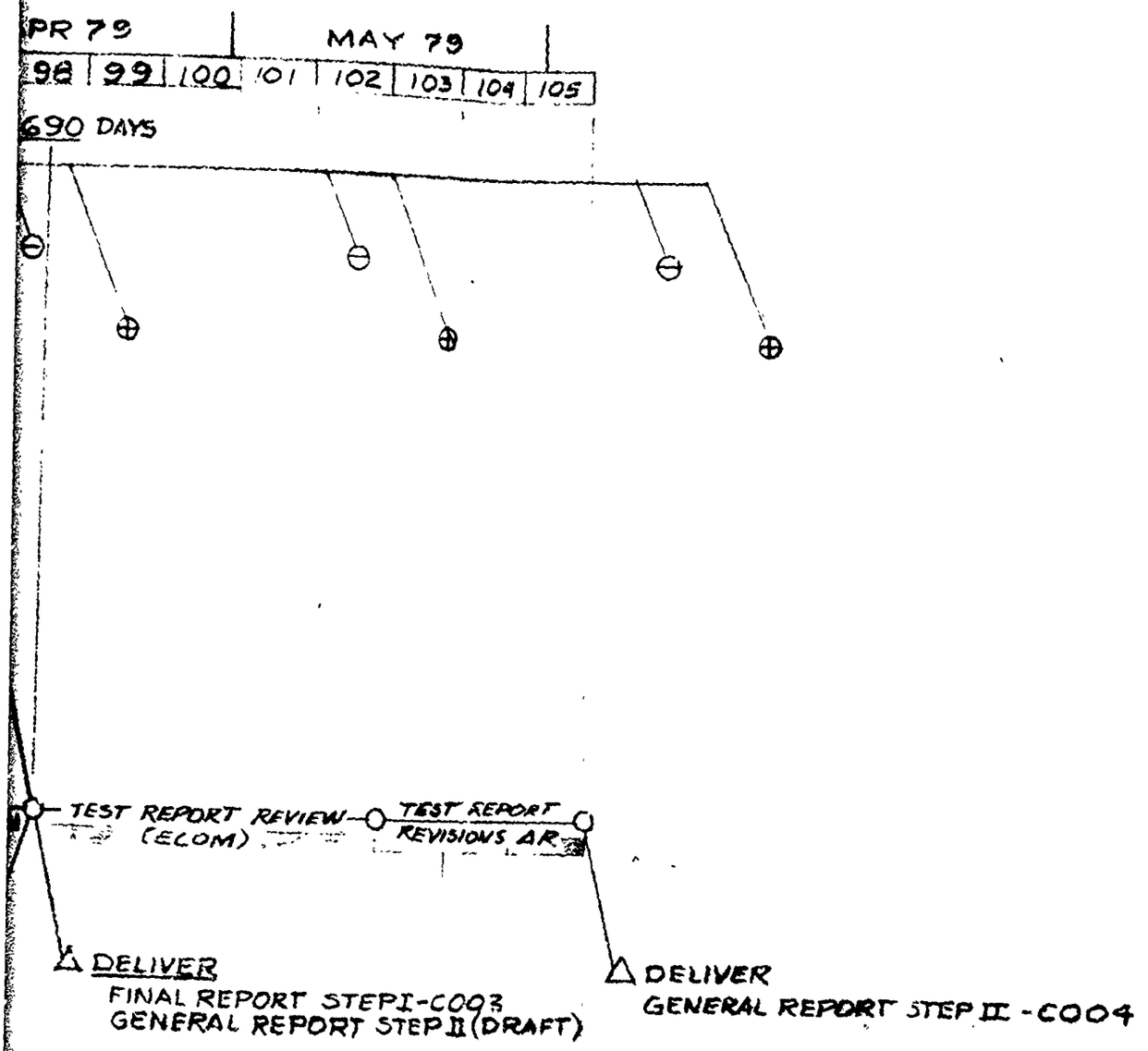
NOTIFICATION RATE VERIFICATION (30 DAYS BEFORE)

PREP FINAL REPORT STEP II

REVISION			
		DATE	APPR SWEDLOW
A	REVISED ENGINEERING SAMPLE DELIVERY FROM 210 TO 273 DAYS AND CONFIRMATION SAMPLE DELIVERY FROM 330 TO 392 DAYS INORDER TO PROVIDE FOR MATERIAL TESTING PRIOR TO ORDERING CROSS PLIED MATERIAL	8-8-77	R DOERR PROPOSED REVISION 7-10-77



ROVAL
ECOM
TELECON APPROVAL PROPOSED REVISION D. BISER 8-4-77



REV A

COPY

BEST AVAILABLE COPY